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भारतीय मानक

पर्यावरण अवस्थाओं का वर्गीकरण

भाग 3 पर्यावरण पेरामीटर और उनकी कठोरताओं के समूहों का वर्गीकरण

अनुभाग 4 गैर-मौसम संरक्षित स्थितियों में उपयोगी लेखन सामग्री

Indian Standard

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 4 Stationary Use at Non-weatherprotected Locations

UDC 621·38·038 : 620·193·21

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NEW DELHI 110002

September 1993 Price Group 9

Environmental Testing Procedures Sectional Committee, LT 02

NATIONAL FOREWORD

This Indian Standard, which is identical with IEC Pub 721-3-4 (1987) 'Classification of environmental conditions — Part 3 : Classification of group of environmental parameters and their severities. Stationary use at non-weatherprotected locations', issued by the International Electrotechnical Commission, was adopted by Bureau of Indian Standards on the recommendations of the Environmental Testing Procedures Sectional Committee (LTD 02) and approval of the Electronics and Telecommunication Division Council.

The text of the IEC standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

> Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

The concerned technical committee has reviewed the provisions of IEC 721-1 (1981), IEC 721-2-1 (1982) and IEC 721-3-0 (1984), referred in this standard and has decided that they are acceptable for use in conjunction with this standard.

Part 1 of this Indian Standard deals with classification of environmental parameters and their severities. The subsequent parts are intended to deal with the following:

a) Environmental conditions appearing in nature

b) Classification of groups of environmental parameters and their severities

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard.

IEC
721-3-7

AMENDMENT 1

1991-06

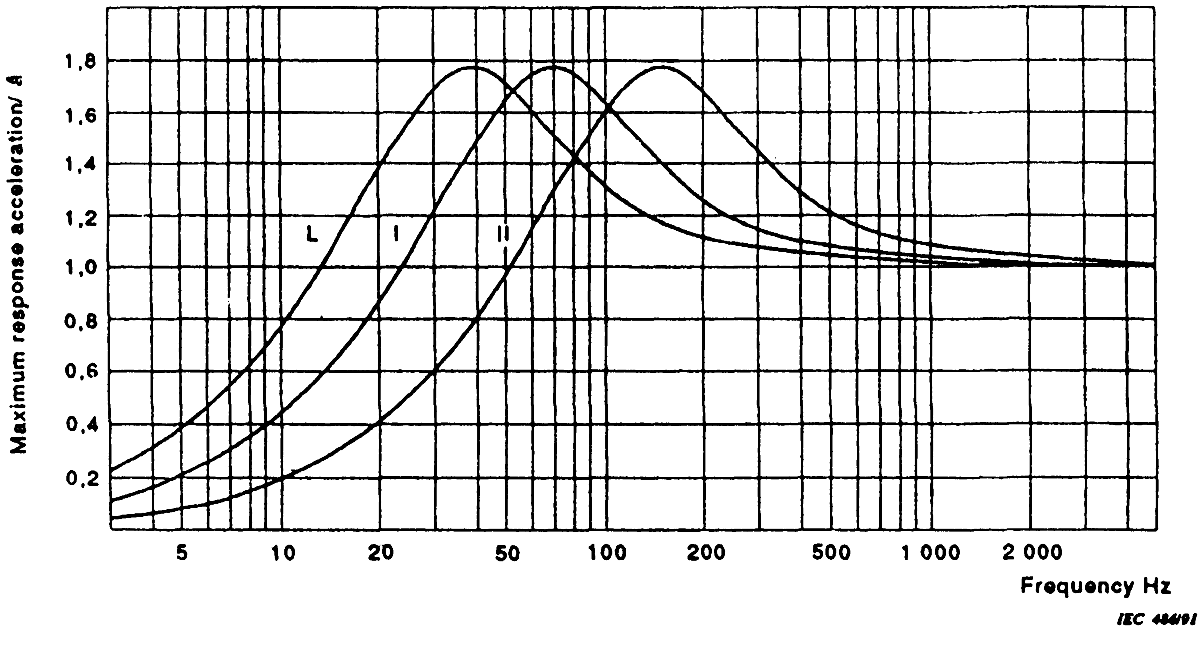
Page 5

TABLE I: *Classification of climatic conditions*

Replace 0,8 *by* 0,9 *in columns "4K1" and "4K4H" for item e).*

Page 8

Replace figure 1 by the following:



***Example of durations for half-sine pulse*:**

Spectrum type L: duration 22 ms
Spectrum type I: duration 11 ms
Spectrum type II: duration 6 ms

Figure 1 - Model shock response spectra (first order maximax shock response spectra). For explanation see note 6 relating to table I of IEC 721-1 (1990)

Page 10

A2.1.1 *Climatic conditions dependent on type of climate*

Replace 0,8 *by* 0,9 *in columns "4K1" and "4K4H" for item e).*

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Indian Standard

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 4 Stationary Use at Non-weatherprotected Locations

1. Scope

This part of the standard classifies groups of environmental parameters and their severities to which products are subjected when mounted for stationary use at locations which are non-weatherprotected.

Locations which are non-weatherprotected, where products may be mounted for stationary use permanently or temporarily, include land-based and offshore locations. Use in and on vehicles is excepted.

The environmental conditions specified in this standard are limited to those which may directly affect the performance of products. Only environmental conditions as such are considered. No special description of the effects of these conditions on the products is given.

Environmental conditions directly related to fire or explosion hazards and conditions related to ionizing radiation are excluded. Any other unforeseen incidents are also excluded. The possibility of their occurrence should be taken into account in special cases.

Microclimate within a product is not included.

Conditions of stationary use at weatherprotected locations, portable and non-stationary use, use in vehicles and ships, and conditions of storage and transportation are given in other parts of the standard.

2. Object

To classify groups of environmental parameters and their severities to which a product may be exposed under its use conditions, including periods of erection work, downtime, maintenance and repair, when mounted for stationary use at locations which are non-weatherprotected.

A limited number of classes of environmental conditions is given, covering a broad field of application. The user of this standard should select the lowest classification necessary for covering the conditions of the intended use. Some guidance for this is given in Appendix A.

3. General

For further general guidance, see IEC Publication 721-3-0: Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and Their Severities – Introduction.

During periods of erection work, which are often connected with downtime, the user should be aware that conditions might differ from those during operation. Therefore, the selection of another class may be necessary for this period, unless special precautions have been taken.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limit values. These values may be reached, but do not occur permanently. Depending on the local situation, there may be different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence have not yet been included in this standard, but should be considered for any environmental parameter. They should be specified additionally if applicable.

Information on duration and frequency of occurrence is included in IEC Publication 721-3-0.

Attention is drawn to the fact that combinations of the environmental parameters given may increase the effect on a product. This applies especially to the presence of high relative humidity in addition to biological conditions, or to conditions of chemically or mechanically active substances.

The environmental conditions present at a location may be affected by other influences, for example heat dissipation sources, special process conditions, etc.

Measurements of the environmental conditions present at a location shall be made at a representative point in the vicinity of the product.

It is recognized that extreme or special environmental conditions may exist. Specifications for products to operate under such special conditions are a matter for negotiation between supplier and user.

4. Definitions

In addition to the definitions in Clause 3 of IEC Publication 721-1: Classification of Environmental Conditions, Part 1: Classification of Environmental Parameters and Their Severities, the following definitions apply to this standard:

4.1 *stationary use*

The product is mounted firmly on the structure or on mounting devices, or it is permanently placed at a certain site. It is not intended for portable use, but short periods of handling during erection work, down time, maintenance and repair at the location are included.

4.2 *location which is non-weatherprotected*

A location at which the product is not protected from direct weather influences.

5. Classification of groups of environmental parameters and their severities

A number of classes for climatic conditions (K), special climatic conditions (Z), biological conditions (B), chemically active substances (C), mechanically active substances (S) and mechanical conditions (M) are specified in Tables I to VI.

This classification allows a number of possible combinations of environmental conditions which bear upon products wherever used. It represents the real situation in respect of worldwide conditions of use, due to local influences of open-air climate, mounting, process conditions, etc.

A class indicated with higher digit conditions normally includes all classes with lower digits.

For certain parameters, it has not yet been possible to specify quantitative severities.

For a given location or product, reference should be made to the total set of classes, for example 4K2 / 4Z1 / 4Z4 / 4Z6 / 4B1 / 4C2 / 4S2 / 4M4.

Appendix A explains the basis of the classes. It contains a summary of the conditions covered by a class and gives a survey of conditions affecting the choice of environmental parameters and their severities.

Appendix B contains a climatogram showing the interdependence of air temperature, relative humidity and absolute humidity.

Appendix C gives examples for practical application of this classification.

5.1 *Climatic conditions*

The climatic conditions specified for classes 4K1 to 4K4 refer to the groups of open-air climates in Sub-clause 5.4 of IEC Publication 721-2-1: Classification of Environmental Conditions, Part 2: Environmental Conditions Appearing in Nature. Temperature and Humidity. Reference values are the mean values of the annual extreme values of temperature and humidity.

At locations which are non-weatherprotected, the influence of special climatic conditions constitutes a more significant share of the effects bearing upon a product and its functional parts than at weatherprotected locations. Particularly the effects of temperature change, solar radiation, precipitation, air velocity and wind-chill should be considered in this respect.

The severity of these effects may be influenced for instance by constructional details (sort and thickness of material, colour of surface, sealing or breathing of casings, product heating, etc.) and by mounting details (selection of mounting site, consideration of degree of exposure to prevailing wind and weather, etc.).

5.2 *Special climatic conditions*

In practice, the parameters heat radiation, movement of surrounding air and water from sources other than rain may occur with any of their severities in combination with any of the other climatic conditions. These parameters are therefore specified as special conditions in Table II. In this case, an assumption of the coincidence of events of increasing severity would lead to unnecessary overdesign.

5.3 *Biological conditions*

No quantitative severities have been specified for these conditions. The specified parameters are typical, but may not be complete.

5.4 *Chemically active substances*

Contamination of natural atmosphere is mainly caused by chemical emissions from industrial activities, motor-driven vehicles and heating systems. A further chemical influence is caused by aerosols of salts. The contamination may affect the function and the materials of products.

The values given in this classification have been encountered in surveys for several years. Maximum values are given because direct influence of higher concentrations over a short period normally causes more damage to materials which cannot regenerate. Average values are given additionally because their influence may be important for the long-term effect on internal parts of the products.

In practice, not all contaminants (parameters) classified in this standard are present simultaneously. Furthermore, the probability is low that the concentrations of those contaminants actually present increase simultaneously and homogeneously. Depending on the local situation, there are often higher values of one contaminant only. The values specified for class 4C1 will normally be experienced in rural areas. The values specified for class 4C2 are experienced in urban areas. Therefore, the severity of each of these two classes shall be considered as the requirements for the combined effect of all parameters stated. The severities of classes 4C3 and 4C4, however, cannot be considered as the requirements for the combined effect of all parameters stated, in order to avoid any uneconomic overdesign. For these classes, it is possible to select only the severities of those single parameters which might be relevant in the particular application. If single parameters of the classes 4C3 or 4C4 are selected for the description of the chemically active substances present at a location, the severities of class 4C2 are valid for all other parameters which are not specially named.

Note. – Chemically active liquids and chemically active solids other than sea salts or road salts are not considered in this standard.

5.5 *Mechanically active substances*

Sand and dust are classified together, as the effects caused by these environmental conditions are similar.

5.6 *Mechanical conditions*

The conditions of vibration (sinusoidal) are classified by severity levels of acceleration and displacement amplitudes in low and high frequency ranges.

Random vibration is not considered in this standard. It may be included when sufficient information is available.

Non-stationary vibration including shock is classified by using the first order undamped maximax shock response spectrum. (See Sub-clause 5.3 of IEC Publication 721-1.)

TABLE I

Classification of climatic conditions

Environmental parameter	Unit	Class					
		4K1	4K2	4K3	4K4	4K4H	4K4L
a) Low air temperature	°C	−20	−33	−50	−65	−20	−65
b) High air temperature	°C	+35	+40	+40	+55	+55	+35
c) Low relative humidity 1)	%	20	15	15	4	4	20
d) High relative humidity 1)	%	100	100	100	100	100	100
e) Low absolute humidity 1)	g/m³	0.8	0.26	0.03	0.003	0.8	0.003
f) High absolute humidity 1)	g/m³	22	25	36	36	36	22
g) Rain intensity	mm/min	6	6	15	15	15	15
h) Rate of change of temperature 2)	°C/min	0.5	0.5	0.5	0.5	0.5	0.5
i) Low air pressure 3)	kPa	70	70	70	70	70	70
j) High air pressure	kPa	106	106	106	106	106	106
k) Solar radiation	W/m²	1 120	1 120	1 120	1 120	1 120	1 120
l) Heat radiation	None	5)	5)	5)	5)	5)	5)
m) Movement of surrounding air	m/s	5)	5)	5)	5)	5)	5)
n) Condensation	None	Yes	Yes	Yes	Yes	Yes	Yes
o) Precipitation (rain, snow, hail, etc.)	None	Yes	Yes	Yes	Yes	Yes	Yes
p) Low rain temperature 4)	°C	+5	+5	+5	+5	+5	+5
q) Water from sources other than rain	None	5)	5)	5)	5)	5)	5)
r) Ice and frost formation	None	Yes	Yes	Yes	Yes	Yes	Yes

1) The low and high relative humidities are limited by the low and high absolute humidities, so that, for instance, for environmental parameters *a)* and *c)*, or *b)* and *d)*, the severities given in Table I do not occur simultaneously. See Appendix B for the relationship between air temperature and humidity.

2) Averaged over a period of 5 min.

3) The value 70 kPa represents a limit value for open-air use, normally at about 3000 m altitude. In some geographical areas, open-air use may take place at higher altitudes.

4) This rain temperature should be considered together with high air temperature *b)* and solar radiation *k)*. The cooling effect of the rain should be considered in connection with the surface temperature of the product.

5) Conditions occurring at the location concerned should be selected from Table II.

TABLE II

Classification of special climatic conditions

Environmental parameter	Class	Unit	Special condition Z
l) Heat radiation[1]	4Z1	None	Negligible
	4Z2	None	Heat radiation due, for instance, to process conditions
m) Movement of surrounding air	4Z3	m/s	20
	4Z4	m/s	30
	4Z5	m/s	50
q) Water from sources other than rain[2]	4Z6	None	Negligible
	4Z7	None	Splashing water
	4Z8	None	Water jets
	4Z9	None	Water waves

[1] Heat radiation may occur in special cases and should be considered where applicable.

[2] Underwater conditions are not considered.

TABLE III

Classification of biological conditions

Environmental parameter	Unit	Class	
		4B1	4B2
a) Flora	None	Presence of mould, fungus, etc.	Presence of mould, fungus, etc.
b) Fauna	None	Presence of rodents and other animals harmful to products, excluding termites	Presence of rodents and other animals harmful to products, including termites

TABLE IV

Classification of chemically active substances

Environmental parameter	Unit	Class						
		4C1	4C2		4C3		4C4	
		Max. value	Mean value	Max. value	Mean value	Max. value	Mean value	Max. value
a) Sea salts and road salts	None	No	Conditions of salt mist					
b) Sulphur dioxide	mg/m^3 cm^3/m^3	0.1 0.037	0.3 0.11	1.0 0.37	5.0 1.85	10 3.7	13 4.8	40 14.8
c) Hydrogen sulphide	mg/m^3 cm^3/m^3	0.01 0.0071	0.1 0.071	0.5 0.36	3.0 2.1	10 7.1	14 9.9	70 49.7
d) Chlorine	mg/m^3 cm^3/m^3	0.1 0.034	0.1 0.034	0.3 0.1	0.3 0.1	1.0 0.34	0.6 0.2	3.0 1.0
e) Hydrogen chloride	mg/m^3 cm^3/m^3	0.1 0.066	0.1 0.066	0.5 0.33	1.0 0.66	5.0 3.3	1.0 0.66	5.0 3.3
f) Hydrogen fluoride	mg/m^3 cm^3/m^3	0.003 0.0036	0.01 0.012	0.03 0.036	0.1 0.12	2.0 2.4	0.1 0.12	2.0 2.4
g) Ammonia	mg/m^3 cm^3/m^3	0.3 0.42	1.0 1.4	3.0 4.2	10 14	35 49	35 49	175 247
h) Ozone	mg/m^3 cm^3/m^3	0.01 0.005	0.05 0.025	0.1 0.05	0.1 0.05	0.3 0.15	0.2 0.1	2.0 1.0
i) Nitrogen oxides (expressed in equivalent values of nitrogen dioxide)	mg/m^3 cm^3/m^3	0.1 0.052	0.5 0.26	1.0 0.52	3.0 1.56	9.0 4.68	10 5.2	20 10.4

Notes 1. – Mean values are the expected long-term values. Maximum values are limit or peak values occurring over a period of not more than 30 min per day.

2. – It is not mandatory to consider each of the classes 4C3 and 4C4 as a requirement for the combined effect of all parameters stated. If applicable, values of single parameters may be selected from these classes. In such cases, the severities of class 4C2 are valid for all parameters not especially named.

3. – The values given in cm^3/m^3 have been calculated from the values given in mg/m^3 and refer to 20 °C and 101.3 kPa. The table uses rounded values.

TABLE V

Classification of mechanically active substances

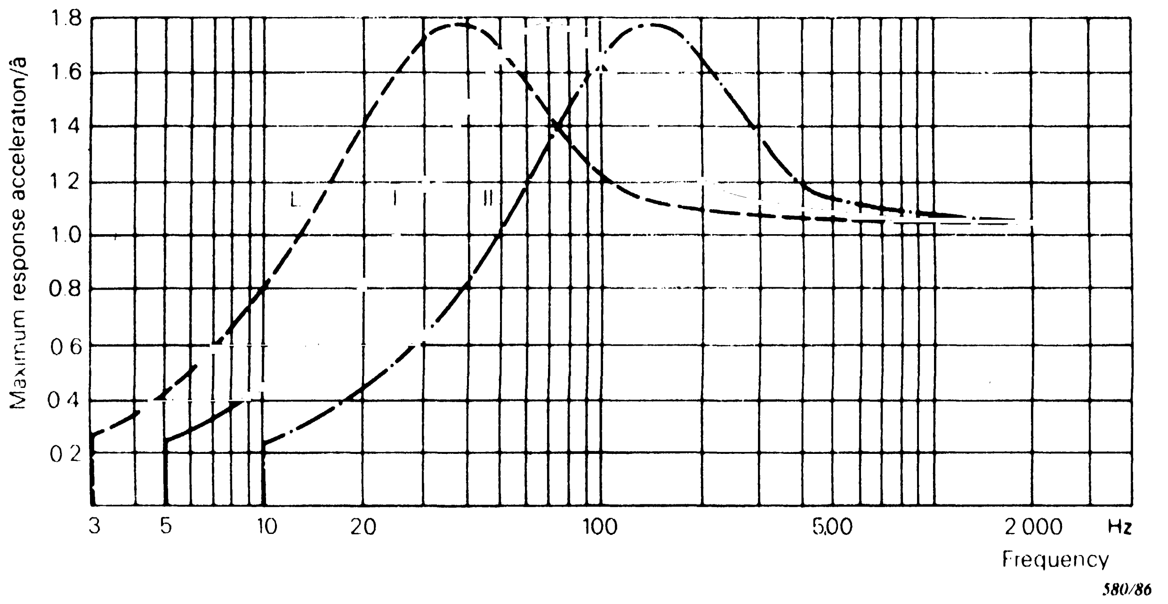
Environmental parameter	Unit	Class			
		4S1	4S2	4S3	4S4
a) Sand	mg/m^3	30	300	1000	4000
b) Dust (suspension)	mg/m^3	0.5	5.0	15	20
c) Dust (sedimentation)	mg/(m^2 · h)	15	20	40	80

TABLE VI

Classification of mechanical conditions

Environmental parameter	Unit	Class							
		4M1	4M2	4M3	4M4	4M5	4M6	4M7	4M8
a) Stationary vibration sinusoidal									
displacement amplitude	mm	0.3	1.5	1.5	3.0	3.0	7.0	10	15
acceleration amplitude	m/s^2	1	5	5	10	10	20	30	50
frequency range	Hz	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200
b) Non-stationary vibration including shock (see note)									
shock response spectrum type L peak acceleration *â*	m/s^2	40	40	70	No	No	No	No	No
shock response spectrum type I peak acceleration *â*	m/s^2	No	No	No	100	No	No	No	No
shock response spectrum type II peak acceleration *â*	m/s^2	No	No	No	No	250	250	250	250

Note. – See Figure 1. For explanation, see IEC Publication 721-1, Sub-clause 5.3.



Spectrum type L	duration = 22 ms
Spectrum type I	duration = 11 ms
Spectrum type II	duration = 6 ms

FIG. 1. – Model shock response spectra
(first order maximax shock response spectra).

APPENDIX A

SURVEY OF CONDITIONS AFFECTING THE CHOICE OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

A1. General

In this appendix, the basis of the classes is explained. It gives a survey of conditions affecting the choice of environmental parameters and their severities, and it contains a summary of the conditions covered by each class.

A2. Survey of conditions

For each environmental parameter, the various possible conditions which will result in different levels of environmental conditions are presented. An effort has been made to arrange the conditions in order of increasing severities.

The first column of the tabulated Sub-clauses A2.1 to A2.5 describes the conditions. In the vertical columns headed "Class", an × indicates the conditions covered by the class. The lowest class covering a certain condition may be found by reading horizontally from that condition to the first × encountered.

The procedure for finding an appropriate class as described above is valid for all the Sub-clauses, but Sub-clause A2.1.1 contains the additional factor of type of climate, given in columns 2 to 10, to which attention has to be paid.

The lowest class covering a certain condition can thus be found by reading vertically down the relevant type of climate column to the first × in the horizontal line of the relevant condition, then reading horizontally to the right to the first × encountered as previously described.

The types of climate are described in IEC Publication 721-2-1 and are:

Extremely Cold (except the Central Antarctic)
Cold
Cold Temperate
Warm Temperate
Warm Dry
Mild Warm Dry
Extremely Warm Dry
Warm Damp
Warm Damp, Equable

It should be noted that the fact that a certain condition referred to in this appendix is covered by a certain class does not necessarily mean that the class describes, for each single parameter, the lowest environmental severity needed to cover the condition.

A2.1 *K. Climatic conditions*

A2.1.1 *Climatic conditions dependent on type of climate*

Condition of stationary use	Type of climate									Class					
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	4K1	4K2	4K3	4K4	4K4H	4K4L
a) Low air temperature °C										−20	−33	−50	−65	−20	−65
Locations directly exposed to open-air climate				×	×	×	×	×	×	×	×	×	×	×	×
			×	×	×	×	×	×	×		×	×	×		×
		×	×	×	×	×	×	×	×			×	×		×
	×	×	×	×	×	×	×	×	×				×		×
b) High air temperature °C										+35	+40	+40	+55	+55	+35
Locations directly exposed to open-air climate	×	×	×	×					×	×	×	×	×	×	×
	×	×	×	×	×	×		×	×		×	×	×	×	
	×	×	×	×	×	×	×	×	×				×	×	
c) Low relative humidity %										20	15	15	4	4	20
Locations directly exposed to open-air climate	×	×	×	×		×		×	×	×	×	×	×	×	×
	×	×	×	×	×	×		×	×		×	×	×	×	
	×	×	×	×	×	×	×	×	×				×	×	
d) High relative humidity %										100	100	100	100	100	100
Locations directly exposed to open-air climate	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
e) Low absolute humidity g/m^3										0.8	0.26	0.03	0.003	0.8	0.003
Locations directly exposed to open-air climate				×	×	×	×	×	×	×	×	×	×	×	×
			×	×	×	×	×	×	×		×	×	×		×
		×	×	×	×	×	×	×	×			×	×		×
	×	×	×	×	×	×	×	×	×				×		×
f) High absolute humidity g/m^3										22	25	36	36	36	22
Locations directly exposed to open-air climate	×	×	×	×						×	×	×	×	×	×
	×	×	×	×	×	×					×	×	×	×	
	×	×	×	×	×	×	×	×	×			×	×	×	
g) Rain intensity mm/min										6	6	15	15	15	15
Locations directly exposed to open-air climate	×	×	×	×	×	×				×	×	×	×	×	×
	×	×	×	×	×	×	×	×	×			×	×	×	×

A2.1.2 *Climatic conditions independent of type of climate*

The following conditions apply to locations directly exposed to open-air climate for all six classes 4K1 to 4K4L:

h) Rate of change of temperature	0.5 °C/min
i) Low air pressure	70 kPa
j) High air pressure	106 kPa
k) Solar radiation	1 120 W/m^2
l) Heat radiation	Special condition Z, see Table II
m) Movement of surrounding air	Special condition Z, see Table II
n) Condensation	Yes
o) Precipitation (rain, snow, hail, etc.)	Yes
p) Low rain temperature	5 °C
q) Water from sources other than rain	Special condition Z, see Table II
r) Ice and frost formation	Yes

A2.2 *B. Biological conditions*

Condition of stationary use	Class	
	4B1	4B2
a) Flora	Presence of mould, fungus, etc.	Presence of mould, fungus, etc.
Locations with risks of growth of mould, fungus, etc. Not protected from growth of mould, fungus, etc.	×	×
b) Fauna	Presence of rodents and other animals harmful to products, excluding termites	Presence of rodents and other animals harmful to products, including termites
Locations with risks of attacks by rodents and other animals, excluding termites Not protected from animals	×	×
Locations with risks of attacks by rodents and other animals, including termites Not protected from animals		×

A2.3 *C. Chemically active substances*

Condition of stationary use	Class						
	4C1	4C2		4C3		4C4	
	Max. value	Mean value	Max. value	Mean value	Max. value	Mean value	Max. value
a) Sea salts and road salts	No	Conditions of salt mist					
b) Sulphur dioxide mg/m^3	0.1	0.3	1.0	5.0	10	13	40
c) Hydrogen sulphide mg/m^3	0.01	0.1	0.5	3.0	10	14	70
d) Chlorine mg/m^3	0.1	0.1	0.3	0.3	1.0	0.6	3.0
e) Hydrogen chloride mg/m^3	0.1	0.1	0.5	1.0	5.0	1.0	5.0
f) Hydrogen fluoride mg/m^3	0.003	0.01	0.03	0.1	2.0	0.1	2.0
g) Ammonia mg/m^3	0.3	1.0	3.0	10	35	35	175
h) Ozone mg/m^3	0.01	0.05	0.1	0.1	0.3	0.2	2.0
i) Nitrogen oxides mg/m^3	0.1	0.5	1.0	3.0	9.0	10	20
Locations in rural and urban areas with low industrial activity and moderate traffic	×	×		×		×	
Locations in urban areas with industrial activity and/or with heavy traffic		×		×		×	
Locations in immediate neighbourhood of industrial sources of chemical emissions				×		×	
Locations with industrial process plants Emission of chemical pollutants in high concentrations						×	

Note. – It is not mandatory to consider each of the classes 4C3 and 4C4 as a requirement for the combined effect of all parameters stated. If applicable, values of single parameters may be selected from these classes. In such a case, the severities of class 4C2 are valid for all parameters not especially named.

A2.4 *S. Mechanically active substances*

Condition of stationary use	Class			
	4S1	4S2	4S3	4S4
a) Sand mg/m^3	30	300	1000	4000
b) Dust (suspension) mg/m^3	0.5	5.0	15	20
c) Dust (sedimentation) mg/(m^2 · h)	15	20	40	80
Locations in rural areas, not in close proximity to sand sources	×	×	×	×
Locations in areas with sand or dust sources, including urban areas		×	×	×
Locations in close proximity to processes producing sand or dust, or in geographical areas with wind-driven sand or dust in air			×	×
Locations permanently exposed to high proportion of airborne sand or dust, due to geographical or process conditions				×

A2.5 *M. Mechanical conditions*

Condition of stationary use	Unit	Class							
		4M1	4M2	4M3	4M4	4M5	4M6	4M7	4M8
a) Stationary vibration sinusoidal									
displacement amplitude	mm	0.3	1.5	1.5	3.0	3.0	7.0	10	15
acceleration amplitude	m/s^2	1	5	5	10	10	20	30	50
frequency range	Hz	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200	2-9 9-200
Locations protected from significant vibration		×	× ×	× ×	× ×	× ×	× ×	× ×	× ×
Locations having vibration transmitted from machines or passing vehicles					×	×	× ×	× ×	× ×
Locations having products mounted directly on machines								×	× ×
b) Non-stationary vibration including shock (see note)									
shock response spectrum type L peak acceleration $\hat{a}$	m/s^2	40	40	70	No	No	No	No	No
shock response spectrum type I peak acceleration $\hat{a}$	m/s^2	No	No	No	100	No	No	No	No
shock response spectrum type II peak acceleration $\hat{a}$	m/s^2	No	No	No	No	250	250	250	250
Locations protected from significant shock		×	×	×	×	×	×	×	×
Locations having shock transmitted from e.g. ground blasting, pile-driving, etc.				×	× ×	× ×	× ×	× ×	× ×
Locations having high level shock transmitted from e.g. machines, conveyor belts, etc.						×	×	×	×

Note. – Alternative classes are given to provide allowance for product design, mounting and intensity of vibration or shock.

A3. Summary of conditions covered by the classes

This summary contains a description of the complete classification and refers to examples of application.

A3.1 *K. Climatic conditions*

These are covered by six class notations as follows:

4K1 4K1 applies to locations which are non-weatherprotected and which are directly exposed to the Restricted Group of Open-air Climates (see IEC Publication 721-2-1) limited to Warm Temperate Type of Climate only.

4K2 In addition to the conditions covered by 4K1, 4K2 applies to locations which are non-weatherprotected and which are directly exposed to the Moderate Group of Open-air Climates including Cold Temperate, Warm Dry and Mild Warm Dry Types of Climate.

4K3 In addition to the conditions covered by 4K2, 4K3 applies to locations which are non-weatherprotected and which are directly exposed to the General Group of Open-air Climates including Cold, Warm Damp and Warm Damp, Equable Types of Climate.

4K4 In addition to the conditions covered by 4K3, 4K4 applies to locations which are non-weatherprotected and which are directly exposed to the World-wide Group of Open-air Climates including Extremely Cold and Extremely Warm Dry Types of Climate.

4K4H Class 4K4H is similar to 4K4, but the low air temperature and low absolute humidity conditions are the same as those of class 4K1.

4K4L Class 4K4L is similar to 4K4, but the high air temperature, low relative humidity and high absolute humidity conditions are the same as those of class 4K1.

In addition to the parameters where severities have been specified for each climatic class, installed products may be subjected to heat radiation, movement of surrounding air and water from sources other than rain. If applicable, severities may be taken from Table II.

A3.2 *B. Biological conditions*

These are covered by two class notations as follows:

4B1 4B1 applies to conditions of locations where mould growth or attacks from animals, excluding termites, may occur.

4B2 In addition to the conditions of 4B1, 4B2 applies to locations where attacks from termites may occur.

A3.3 *C. Chemically active substances*

These are covered by four class notations as follows:

4C1 4C1 applies to conditions of locations in rural and urban areas with low industrial activity and moderate traffic. Coastal areas are not covered by this class.

4C2 In addition to the conditions of 4C1, 4C2 applies to locations with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area or with heavy traffic. It also applies to coastal areas.

4C3 In addition to the conditions of 4C2, 4C3 applies to locations in the immediate neighbourhood of industrial sources of chemical emissions.

4C4 In addition to the conditions of 4C3, 4C4 applies to locations within industrial process plants. Emissions of chemical pollutants may occur in high concentrations.

A3.4 *S. Mechanically active substances*

These are covered by four class notations as follows:

4S1 4S1 applies to conditions of locations in rural areas. Sand sources are not expected to be in close proximity.

4S2 In addition to the conditions of 4S1, 4S2 applies to locations in areas with sand or dust sources, including urban areas.

4S3 In addition to the conditions of 4S2, 4S3 applies to locations in close proximity to processes producing sand or dust, or in geographical areas with wind-driven sand or dust in air.

4S4 In addition to the conditions of 4S3, 4S4 applies to locations which are permanently exposed to a high proportion of airborne sand or dust, due to geographical or process conditions.

A3.5 *M. Mechanical conditions*

These are covered by eight class notations as follows:

4M1
4M2 4M1 and 4M2 apply to locations which are protected from significant vibration and shock.

4M3 In addition to the conditions covered by 4M1 and 4M2, 4M3 applies to locations which are protected from significant vibration, but may receive some transmitted shock, for instance from local blasting or pile-driving activities.

4M4 In addition to the conditions covered by 4M3, 4M4 applies to locations where transmitted vibration from machines or passing vehicles is experienced.

4M5
4M6 In addition to the conditions covered by 4M4, 4M5 and 4M6 apply to locations where higher level shock may be experienced, for instance from adjacent machines or conveyor belts.

4M7
4M8 In addition to the conditions covered by 4M5 and 4M6, 4M7 and 4M8 apply to locations having products mounted directly on machines, receiving high level vibration and shock from them.

Note. – Selection of the relevant class is dependent on product design and mounting and on the intensity of vibration or shock.

APPENDIX B

INTERDEPENDENCE OF AIR TEMPERATURE, RELATIVE HUMIDITY AND ABSOLUTE HUMIDITY

B1. General

This appendix contains a climatogram (see Figure B1) showing the interdependence of air temperature, relative air humidity and absolute air humidity.

For a given severity of low or high absolute air humidity, the relevant severity of relative air humidity at a given air temperature within the temperature range of a class may be found at the point where the curve for constant absolute air humidity cuts the straight line for air temperature and relative air humidity.

B2. Example

In class 4K4, the limiting severity for absolute air humidity is 36 g/m^3.

This means:

25% relative air humidity at a temperature of 60 °C
42% relative air humidity at a temperature of 50 °C
67% relative air humidity at a temperature of 40 °C
100% relative air humidity at a temperature of 33 °C

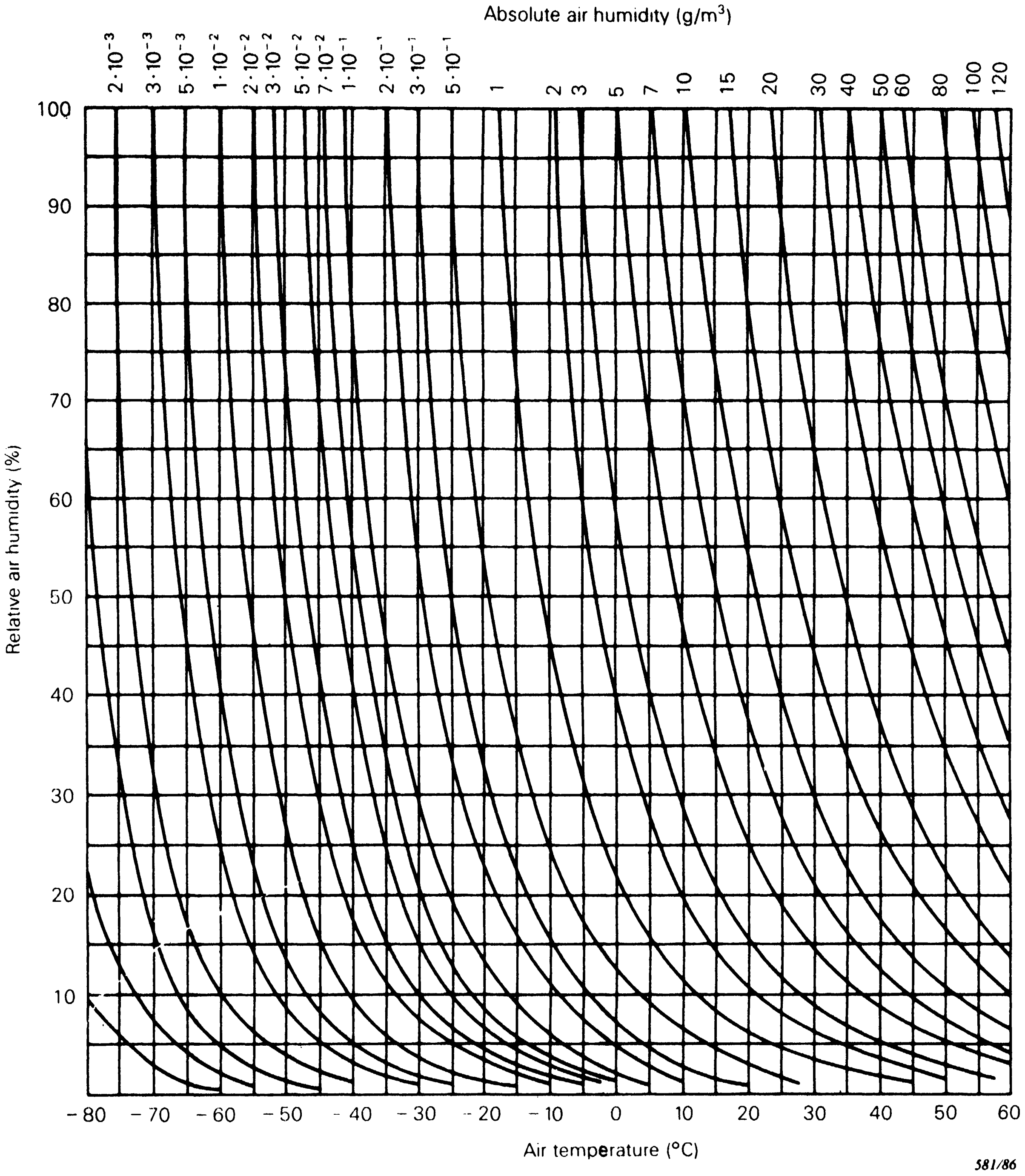


FIG. B1. – Climatogram. Interdependence of air temperature, relative air humidity and absolute air humidity.

APPENDIX C

EXAMPLES OF PRACTICAL APPLICATION OF THE CLASSIFICATION SPECIFIED IN THIS STANDARD

C1. **General**

These are examples of how to classify a location or a product for use in a certain location, in accordance with the classification given in this standard.

C2. **Examples for locations**

Examples of details to be given by the user to inform the manufacturer about the environmental conditions at the location where the product is to be used.

C2.1 *Example No. 1*

C2.1.1 *Brief description of location*

Road junction in small town with industry
(site for traffic signal)

Regional open-air climate:
Cold Temperate

C2.1.2 *Classification*

The classes appropriate for this location are underlined in the table below:

K	Climatic conditions	4K1 4K2 4K3 4K4 4K4H 4K4L
Z	Special climatic conditions	4Z1 4Z2 4Z3 4Z4 4Z5 4Z6 4Z7 4Z8 4Z9
B	Biological conditions	4B1 4B2
C	Chemically active substances	4C1 4C2 4C3 4C4
S	Mechanically active substances	4S1 4S2 4S3 4S4
M	Mechanical conditions	4M1 4M2 4M3 4M4 4M5 4M6 4M7 4M8

Summary: 4K2 / 4Z1 / 4Z3 / 4Z7 / 4B1 / 4C2 / 4S2 / 4M4

C2.2 *Example No. 2*

C2.2.1 *Brief description of location*

Production plant for nitrogenous fertilizer
(site for process control equipment, for instance signal transducer)

Regional open-air climate:
Warm Dry

C2.2.2 *Classification*

The classes appropriate for this location are underlined in the table below:

K	Climatic conditions	4K1 4K2 4K3 4K4 4K4H 4K4L
Z	Special climatic conditions	4Z1 4Z2 4Z3 4Z4 4Z5 4Z6 4Z7 4Z8 4Z9
B	Biological conditions	4B1 4B2
C	Chemically active substances	4C1 4C2 4C3 4C4*
S	Mechanically active substances	4S1 4S2 4S3 4S4
M	Mechanical conditions	4M1 4M2 4M3 4M4 4M5 4M6 4M7 4M8

Summary: 4K2 / 4Z1 / 4Z4 / 4Z6 / 4B1 / 4C4* / 4S3 / 4M4

* For ammonia and nitrogen oxides.

C3. Examples for products

Examples of details to be given by the supplier to inform the user that the product intended for use at the operating location in question fulfils the conditions of the classes stated.

C3.1 *Example No. 1*

C3.1.1 *Brief description of location*

The description is identical with C2.1.1.

C3.1.2 *Classification*

The classes appropriate for the product are as indicated in the following table:

K	Climatic conditions	4K2
Z	Special climatic conditions	4Z1 + 4Z3 + 4Z7
B	Biological conditions	4B1
C	Chemically active substances	4C2
S	Mechanically active substances	4S2
M	Mechanical conditions	4M4

Summary: 4K2 / 4Z1 / 4Z3 / 4Z7 / 4B1 / 4C2 / 4S2 / 4M4

C3.2 *Example No. 2*

C3.2.1 *Brief description of location*

The description is identical with C2.2.1.

C3.2.2 *Classification*

The classes appropriate for the product are as indicated in the following table:

K	Climatic conditions	4K2
Z	Special climatic conditions	4Z1 + 4Z4 + 4Z6
B	Biological conditions	4B1
C	Chemically active substances	4C4*
S	Mechanically active substances	4S3
M	Mechanical conditions	4M4

Summary: 4K2 / 4Z1 / 4Z4 / 4Z6 / 4B1 / 4C4* / 4S3 / 4M4

* For ammonia and nitrogen oxides.

CORRIGENDUM

Page 5

Table I, Classification of climatic conditions, in column 4K1 for item e), change 0.8 *to* 0.9.

Page 10

Subclause A2.1.1, Climatic conditions dependent on type of climate, in column 4K1 for item e), change 0.8 *to* 0.9.

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AMENDMENT 1

1991-06

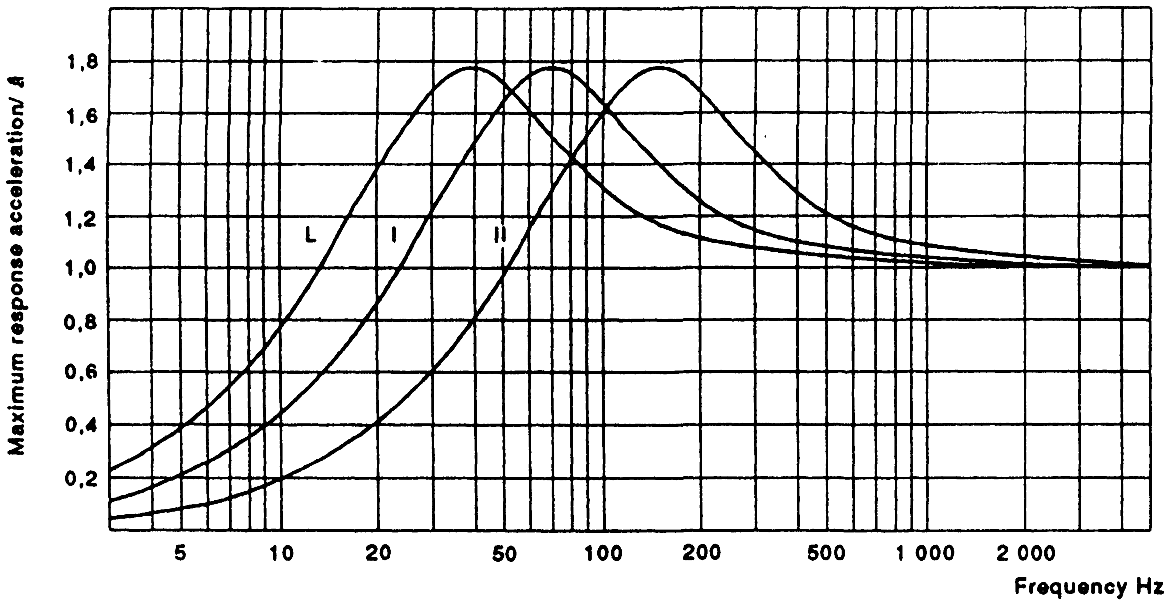
Page 5

TABLE I: *Classification of climatic conditions*

Replace 0,8 *by* 0,9 *in columns "4K1" and "4K4H" for item e).*

Page 8

Replace figure 1 by the following:



IEC 486/91

***Example of durations for half-sine pulse*:**

Spectrum type L: duration 22 ms
Spectrum type I: duration 11 ms
Spectrum type II: duration 6 ms

Figure 1 - Model shock response spectra
(first order maximax shock response spectra).
For explanation see note 6 relating to table I
of IEC 721-1 (1990)

Page 10

A2.1.1 *Climatic conditions dependent on type of climate*

Replace 0,8 *by* 0,9 *in columns "4K1" and "4K4H" for item e).*

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